PAPER ON
RECATEGORISATION TRIALS WITH
EXPLOSIVES AND AMMUNITIONS.

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Report Documentation Page

Form Approved
OMB No. 0704-0188

1. REPORT DATE **AUG 1990**	2. REPORT TYPE	3. DATES COVERED **00-00-1990 to 00-00-1990**
4. TITLE AND SUBTITLE **Recategorisation Trials with Explosives and Ammunition**		5a. CONTRACT NUMBER
		5b. GRANT NUMBER
		5c. PROGRAM ELEMENT NUMBER
6. AUTHOR(S)		5d. PROJECT NUMBER
		5e. TASK NUMBER
		5f. WORK UNIT NUMBER
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) **Ordnance Factory,Chanda, 422 501, India,**		8. PERFORMING ORGANIZATION REPORT NUMBER
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)		10. SPONSOR/MONITOR'S ACRONYM(S)
		11. SPONSOR/MONITOR'S REPORT NUMBER(S)
12. DISTRIBUTION/AVAILABILITY STATEMENT **Approved for public release; distribution unlimited**		
13. SUPPLEMENTARY NOTES **See also ADA235005, Volume 1. Minutes of the Explosives Safety Seminar (24th) Held in St. Louis, MO on 28-30 August 1990.**		
14. ABSTRACT		
15. SUBJECT TERMS		

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT **unclassified**	b. ABSTRACT **unclassified**	c. THIS PAGE **unclassified**	**Same as Report (SAR)**	**12**	

Standard Form 298 (Rev. 8-98)
Prescribed by ANSI Std Z39-18

SAFETY WITH EXPLOSIVES

The ammunitions and Explosives, although they constitute a major part of the military hardware and involve military personnel and are, in general,thought to be used and handed only by the soldiers in the warfield, they do, indeed, if viewed from a wider angle, involve quite a considerable percentage of the civilian population, whether directly or indirectly in so far as their process of manufacture, storage and transportations are concerned. They potentially pose a very high degree of risk to the process operatives, the Engineers, the people dwelling around the manufacturing units and also to the inhabitants in the surroundings of a storage area. During transportation over long distances innumerable people as well as country's valuable properties in various forms and publid utilities do get exposed to the severe hazards. Hence, there is an utter necessity for paying a judicious thought to the problem and an effective action needed in their management. The potency of the explosives has necessarily to be judged rightly and safety norms decided accordingly. Handling of ammunitions and explosives need involvement of as much high technology as it should involve an improved methodology. The Explosive industry is a growing one. The necessity of this industry, their progress and development cannot, in any way, be ruled out. Development of new explosive stores and their manufacture is an ever demanding affair. The purpose is not for any offensive action but is positively for the cause of defence. It is a guarantee towards the security of a country and her people. Considered in this perspective, safety with explosives is of paramount importance and it plays a titanic role in their handling thus making itself a subject of top interest and of human considerations. Scholars in the field, all over the Globe, have been showing keen interest in the subject, they have been putting their untiring efforts and conducting research works in formulating various safey norms and improving the standards of safety.

While much has been achieved in this direction, much more still remain to be done in this field.

Immediately after the IInd World War, there arlse the necessity of holding large stocks of explosives in many countries. To do this tremendous task, efforts had been put up by experts to tackle the problem and achieve a desired level of safety. Based on available damage data, the devastating effects of explosions in the war and through conductance of planned and organised trials with large quantities of explosives, certain empirical formulae and desired safety standards in handling of explosives could be set up for the first time. These had in the subsequent years undergone several modifications in the hands of expertrs in the field after a careful study of the characteristics of different explosives stores. The explosivies were then grouped according to their hazardous behavious and characteristics for the purpose of storage and transportation and the norms thus set up were followeo by various countries. They were in vogue over a long interval of time until U N Experts felt the necessity of adopting a uniform policy and made an attempt to place them in proper system based on a scientific analysis.

The classifications of explosives thus brought out in the U.N system according to their hazard potential is considered to be a very progressive step and the norms adopted by many countries over the world. India has also adopted the same in a phased manner judging their merit over the old model of explosive groupings. Even though UN classification system of explosives and ammunitions presents store-wise distinct H.D and compatibility group label, Indian experts felt the necessity of conduting certain re-categorisation trials with various ammunition in order to find as to whether these can be placed further to lower hazard dividions, without ofcourse any compromise to safety. The purpose was mainly to accommodate more explosives stores in the storages and also in the process buildings and to find out substitute materials for packing and ascertaining correct H.D with these. Extensive work has been done in this

specialised wing and several trials on recategorisation conducted in India with various types of ammn. and explosive components based principally on the procedures and norms prescribed in the literature published by the UN experts. Described below, in a nutshell, are a few illustrative cases. However, prior to elaboration of the cases, it is considered worth to have a glimpse on the advantages which also led to the thought for such a venture. The advantages are:-=

1) Direct verification of the already established H.D i.e. study of en-masse explositions or a sporadic explosion which may taken place with a particular type of ammn when held in considerable Qty. at one place or put in modified packages or otherwise.

2) Piece-meal study of the behaviour and characteristics of an ammunition in its nacked stage, in the containered stage and also in the stage of this being in finally packed conditions.

3) Observation of effects of explosions or damage caused to the distance from its explosion site, i.e a test of its potention or power of damaging or lethality due its known and calculated explosive content which add to direct knowledge owing to such a deliberate study/observation which otherwise is not possible in any accidental explosion.

4) A further verification of the Quantity distance criteria and fixation of revised explosive limit of an explosive building based on new data/observation of recategorisation trial designing of racks and stacks for different types of stores based on extent of detonation effects as observed in such trials.

5) Design improvement of packages, selection of new materials as packing substitutes and thereby improvement in value engineering and achieving economy in parallel with safety.

6) Understanding and predicting approximate HD of ammn.of similar type and the developmental stores.

7) Be-holding it as a media of learning through observation of the effects and influencing people for the necessity of adoption of safety norms through observation of these effects and discussions thereon.

8) Assessment of fire hazard character of the store and determi8nation of circle dia of such fire hazards due to flying of hot fragments from the site of explosion.

9) Determination of escape time for the operatives in an explosive building incase of an eventuality.

10) Incase of categorisation to lower H.D, advantages are had for fie fighting in regard to approach to the scene and availability of enhanced time at the disposal of fire fighting personnel, since the risk decreases with the increse in the numerial value of the H.D.

11) Re-categorisation to a lower H.D reduces the risk to the surroundings whether in storage or during transportation.

However, reverting to our earlier discussions, let the account of a few re-categorisation trials, so conducted keeping the above in view be placed here. It is once again reiterated that the object of such trial is to minimise the risk and to find out the guidelines as the solution to our problems.

TRIAL I.

1.	Propellent:	NGB 051 NGB 011	Double based flake propellents.
		NGB 688	Single based powder propellent.

The above propellants were under H.D 1.1

2. PACKING - These are first bagged in cambric cotton bags(15 Kgs. each) one such bag is placed inside a metallic C 27A container and finally two C 27A containers

are packed in one C 26 A wooden rectangular package. Thus each C 26 A package contains 30.00 Kgs. of the propellant material.

3. PROCEDURE.

A) SINGLE PACKAGE TEST:-

The card board cotton)vol.apx. 0.15 m3) was placed over a 3 mm thick M.S plate on the ground. The cotton was completely filled with th propellant. It contained a qty.of 135.00 Kgs. in case of all three propellants. A thin polythene tube containing 30.000 g of G 12 was placed in the mid-depth of the propellant. Fuze No. 11 (Length 2000mm) was inserted in the gun powder. The propellant container was tamped all around with sand filled bags to give a 500 mm thick confinement in all directions. The fuze was lit using a safety match.

OBSERVATIONS:

No detonation. Material burnt off with a mild bang and in other two cases without any bang.

B. STACK TEST.

Five Nos.of C 26 A packages containing propellants were arranged over the witness plates. One package at bottom was opened and in one of the C 27A containers inside this package, a polythene tube containing 30.00 gm of Gun powder and fitted with safety fuze 11 (2000 mm) was placed in the propellant material. This container and package was closed in the normal manner. All the packages wcrc tamped with sand bags to give a confinement of around 1000 mm thick. Ignition was then initiated.

OBSERVATIONS:-

Burning with hissing sound and bright flames.

C) BON FIRE TEST:-

An iron grill was placed in four holes dug on a pre-selected site, with a clear space of about 750 mm available above the ground level. Three aluminium screens were placed in three different directions at distance of 4 mts. from the respective corners of the iron grills. These screens

were erected at a height of about 700 mm above the ground level and the open space between two screens was kept from 3 to 3.5 metres. The 4th side was kept wide open.

Propellants packed in 10 Nos. of C26A packages (300.00 Kg in total) were placed on the Iron Grill in twor rows. Adequate quantity of fire wod was placed below the grill and all around the packages. Kerosene was sprinkled profusely on the fire wood. The fire wood was ignited usigng about 5.00 Kg of wastepropellant and safety Fuze No. 11 (4500 mm length).

OBSERVATION:

Propellant (360.00 Kgs) in 12 Nos.of C 26 A packages burnt off with very brilliant flames, with occasional hissing sound. No efect observed on Alu. screens. There was no detonation.

4. CONCLUSION.

Categorised as U.N.H.D 1.3 since all norms confirm to stipulations of U.N. H.D 1.3.

TRIAL II.

1. Hazard classification of fuze B 429 packed in wooden Box F1A.

2.PACKING;-

Fuze B 429 with exploder, assembled with adapter is packed in plastic container 59 A and 12 such containers are housed in wooden box F1A.

Fuzes containing exploder pellets are generally classified under H.D 1.1. Considering that the exploder pellet is housed in a metal adapter and mode of packing of fuze, it was felt that the fuze assembled with adopter may behave as hazard division 1.2 explosives. It was, however, necessary to confirm the correct hazard division by carrying out categorisation trials. Categorisation trials were carried out to ascertain the correct category of fuze B 429 assembledwith adopter containing exploder pellet.

3.PROCEDURE.

BOX TRIAL:-

The box containing 12 fuzes were placed in a pit dug in the ground. It was tamped with sand to provide thick barrier all around.

To facilitate initiation of the fuze in the centre, the exploder pellet in the adopter was removed. The closed end of the adopter was cut and a through hole was made in the adopter. The adopter was reassembled with fuze and CE pellet (about 10 gm) was inserted through this hole in the adopter. The above CE pellet, by using a small qty.of PEK 1, was connected with a double lead of prima cord. The free end of the prima cord was detonated using CE primer, safety fuze and detonator No.27. The trial was repeated three times.

OBSERVATION:-

The fuze initiated, detonated completely. The remaining fuzes were intact and were found scattered within a radius 10 m from the site of trial in all the above three cases

4.CONCLUSION:-

Since en-masse explosion did not occur in any of the successive box trials, it can be concluded that Fuze B 429 assembled with adopter containing exploder pellet, when packed in plastic container 59 A and 12 such containers housed in wooden box F1A, does not carry en-masse explosion risk.

Fuze B 429 assembled with adopter containing exploder pellet, when packed in plastic container 59A and 12 such containers housed in wooden box F1A, is assigned hazard division 1.2.

TRIAL III.

1. Verification of the design of wooden racks for storages of unfuzed 81 mm HE mortor bombs in inter-stage storage buildings.

2. OBJECTIVE.

By providing adequate spacing (air gap) between HE filled shells the chances of sympathetic detonation can be avoided and unit risk principle can be applied to cater foor increased explosive holdings in buildings. This spacing can be further reduced by providing suitable partition of wood or metal between the shells. The spacing can be calculated from the following formulae reported in the literature:

$$S = 14.3\ C2\ W - 3/2$$

where S is spacing in cm.

C is the weight of HE filling in g

and W is the weight of filled shell in g

For HE filled shells, C = 0.7 Kg and W = 4.2 Kgs, value of S works out to 17.8 cm. From the literature,it is noted that a large No.of trials using 105 mm HE shells have been carried out in UK and it has been found that 10.8 cm air gap is equivalent to 1 .25 cm thick plywood partition between the shells. By providing extra margin fo safety wooden racks were fabricated with the following design features:

Spacing between the bombs + 9.5 cm

Thickness of wooden partition = 2.5 cm

Wooden racks to the above design have been provided for storage of 81 mm HE filled shells in inter-stage storage buildings, awaiting X ray examination results. With the above arrangements, it is considered that chances of sympathetic detonation from round to round are not likely/.

PROCEDURE.

(A) RACK TRIAL.

Wooden rack along with five bombs, was placed in a pit dug in the ground. It was tamped from all sides

with sand bags to provide a thick barrier. All the rounds were facing in one direction and were without fuze and tail unit simulating the storage conditions in the inter-stage storage buildings.

To facilitate the initiation of the round at the centre of the rack, a CE pellet was inserted in the fuze housing. The CE pellet by using a little qty of PEK 1, was connected with the double lead of prima cord. The free end o the prima cord was detonated using GC primer, detonator No.27 and safety fuze. The trial was repeated three times.

OBSERVATIONS

The round initiated detonated completely. The remaining four rounds were found within a distance of 5 to 10 m from the site and these were not detonated. One of the rounds in one trial out of the three broke in two pieces from the middle with explosive filling intact.

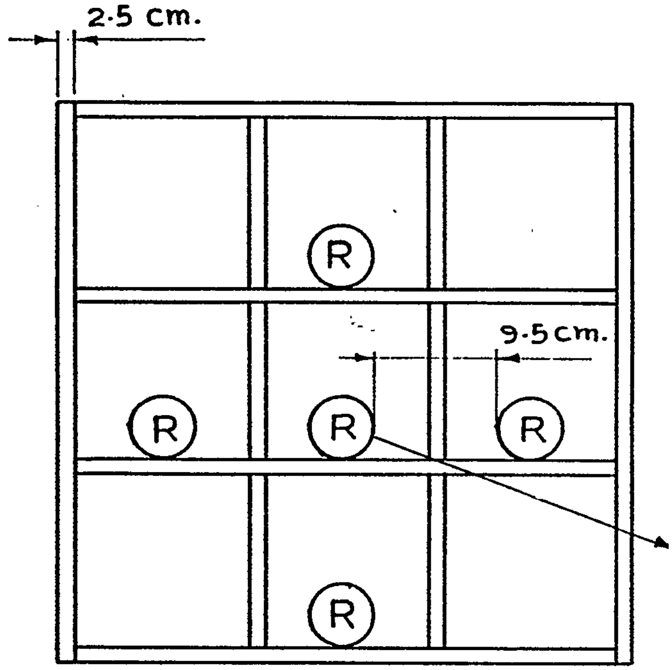
B. GAP TEST.

For the sake of data collection, a gap test was also carried out by keeping the two 81 mm HE Mortar bombs with fuze and tail unit assembly side by side. Axes of both the rounds were parallel to each other. They were ket 9 cm apart as shown in sketch II. One of the round was detonated to see the effect on the other. This trial was carried out only once. After detonation the second round was found within the pit with fuze intact.

4.CONCLUSION

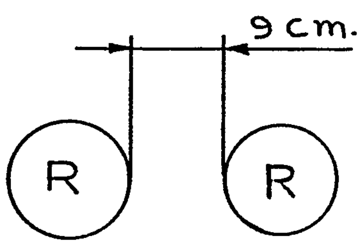
From the trial results, it was concluded that no explosion will be communicated to adjacent 81 mm bombs when stored in specially designed woodn racks as has been involved in this trial.

HE filled 81 mm Mortar Bombs, without fuz tail unit assembly can be stored in wooden racks of 2.5 cm thick wood and spacing of 9.5 cm round to round and there is no likelyho sympathetic detonation between the rounds ir arrangements.



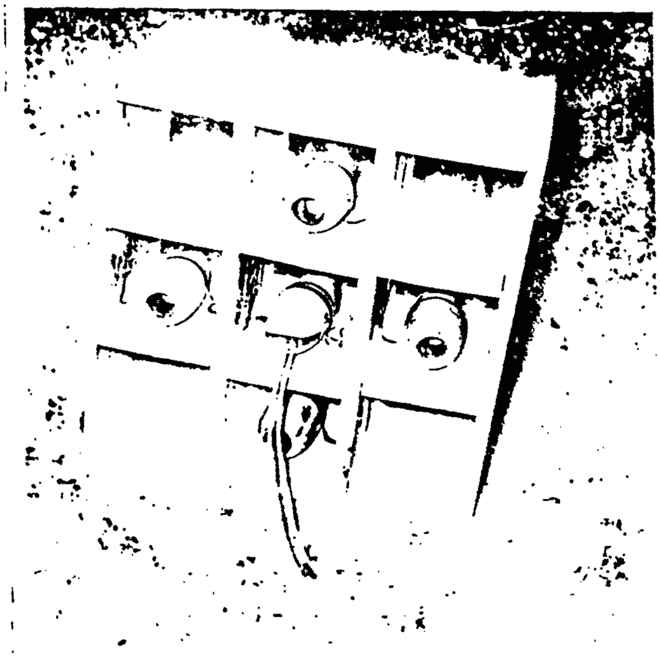
SKETCH - I

RACK TRIAL



SKETCH - II

GAP TEST



Arrangement of Bomb 81 mm HE in a wooden rack with double lead of cordtex connected to CE Pellet for initiation of the central round.